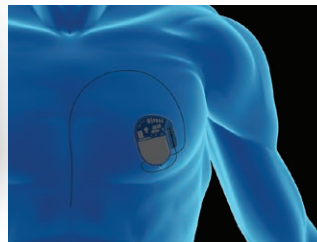


**technology opportunity**

Battery Monitoring System Logs, Processes, and Transmits Sensor Data Wirelessly

Assessing battery health in real-time with commercial, off-the-shelf parts



Engineers at NASA's Armstrong Flight Research Center have developed a battery data acquisition and logging system that processes and reports analog sensor data in real-time for wireless transmittal. In combination with customized algorithms, the system is part of a novel battery health management structure for electric unmanned aerial vehicles (UAVs). Constructed with commercial off-the-shelf (COTS) parts, this low-cost and novel battery monitoring system (BMS) is adaptable to multiple types of battery chemistry, creating cross-platform capabilities for a wealth of sensing needs. In addition to use with electric UAVs, potential applications include electric vehicles (EVs), medical devices, instrumentation, and robotics.

Benefits

- **Improved safety:** Prevents occurrence of catastrophic battery failure by predicting the remaining useful life (RUL) of battery systems, when used in combination with customized algorithms
- **Powerful:** Processes large amounts of data and reports results wirelessly
- **Effective:** Monitors the health of multiple batteries simultaneously
- **Reliable:** Enables a critical, real-time monitoring capability that allows an immediate and controlled response to avoid battery failure
- **Low-cost:** Includes use of COTS parts, increasing affordability and contributing to a lightweight, compact footprint
- **Rugged:** Provides a robust platform for multiple sensing needs, with the potential for miniaturization
- **Unique:** Features custom-developed software that processes and sends real-time data reports wirelessly

Applications

- Electric UAVs
- High Altitude Long Endurance Aircraft (HALE)
- EVs
- Hybrid Electric Vehicles (HEVs) and Plug-in Hybrid Electric Vehicles (PHEVs)
- Light rail systems
- Medical devices
- Robotics
- Industrial instruments
- Critical battery systems
- Vehicle to grid (V2G) power systems
- Grid stationary power systems
- Uninterruptible power supply (UPS) systems
- Autonomous underwater vehicles (AUVs)
- Auxiliary power units for aircrafts and heavy vehicles
- Military portable power packs

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Office, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider opportunities for partnership and usage of the Battery Health Monitoring System technology (DRC-011-006).

Technology Details

Battery health monitoring is an emerging technology field that seeks to predict the RUL of battery systems before they run out of charge. Such predictive measures require interpretation of large amounts of battery status data within a Bayesian prognostic framework. When used in combination with customized algorithms, the Armstrong innovation provides a means to collect, process, and transmit this critical useful life data from lithium-ion (Li-ion) batteries and other battery chemistries.

How It Works

The Armstrong innovation uses an embedded processor board for digital signal acquisition and an embedded computer-on-module expansion board for recording and manipulating data. Custom-developed C code runs on both platforms and enables on-board data processing in addition to a binary data stream output via an RS-232 data link. Within the NASA-developed BMS structure, the innovation creates an ASCII log of connected sensors that transmits data to a laptop receiver. Measurements include battery voltage, temperature, and state of health for multiple Li-ion batteries simultaneously. Results are archived on a local memory card with flash memory capability. Wireless transmittal is accomplished flexibly with a serial output port attached to a wireless transmitter.

The design features COTS parts to provide an affordable and lightweight solution to gathering and reporting complex sensor tasks. While the Armstrong innovation utilizes a unique NASA algorithm, designers with expertise in Bayesian inference-driven prognostics can adapt and optimize the system for similar monitoring uses.

Why It Is Better

Existing methods of battery health monitoring often rely on periodic testing and therefore miss long time intervals during which a battery's health can degrade. Various factors such as ambient storage temperatures, terminal voltage, and power requirements also affect battery health and make it difficult to predict battery failure. The Armstrong innovation works in tandem with a NASA-developed algorithm to collect, interpret, and transmit critical battery health data in order to generate meaningful battery life information. The methodology does not simply provide time-to-failure estimates but further generates a probability distribution over time that best encapsulates the uncertainties inherent in system models.

Such information enables real-time monitoring capability beyond that which is currently available, particularly for applications where unanticipated battery performance may lead to catastrophic failures, such as aerospace and medical device systems. For EVs, the technology can help to mitigate the driving distance, battery life, and thermal uncertainties that plague high-cost EV batteries. The customizable structure of the Armstrong technology combines battery state estimation with model adaptation to better predict battery performance.

For more information about this technology, please contact:

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